In-Situ and Ex-Situ Remediation of cVOC Impacts in Conjunction with Site Construction Activities:

Challenges & Perspectives from the Landowner, Consultant and Remedial Contractor

Remtech East 2023

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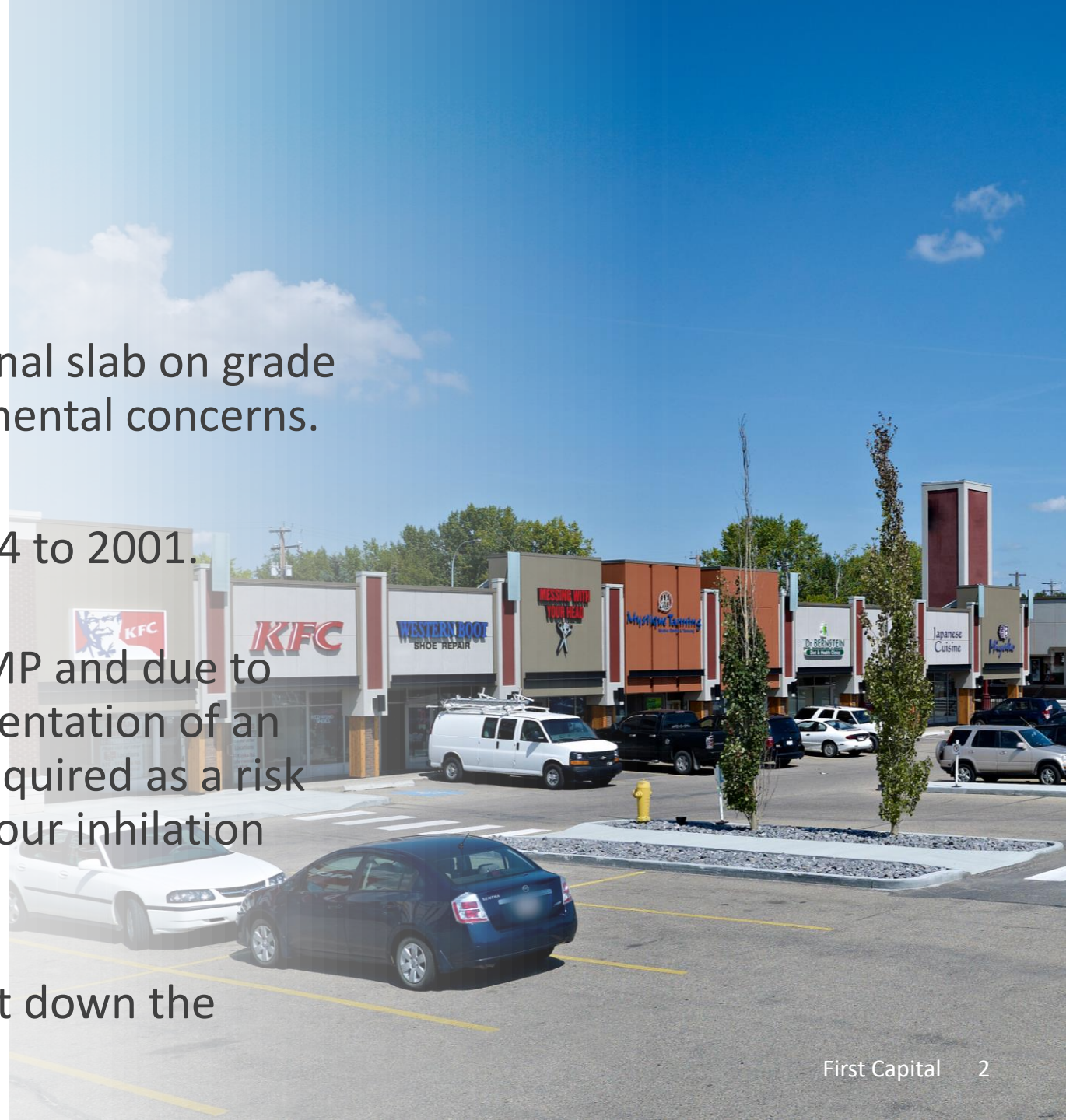
Introduction

- Acquired property in early 2000s, original slab on grade construction 1960. No major environmental concerns.
- Former dry cleaner operated from 1994 to 2001.
- Soil and groundwater exceedance – RMP and due to changes in standards 2017 the implementation of an active vapour mitigation system was required as a risk management approach to address vapour inhilation risk.
- April 2021, a fire caused by arson burnt down the building



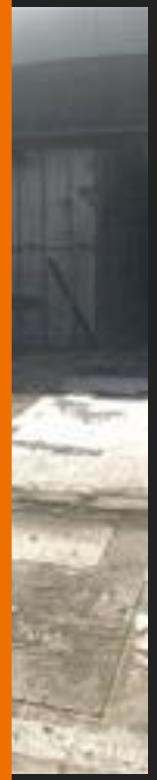
Opportunities

1. Remediate prior to reconstruction (while shopping centre continues to operate)
2. Remove RMP requirement including to operate vapour mitigation system
3. Excavated contaminated hot spot
4. In-situ remediation of groundwater

Expected Timelines

1. September 29 to October 8: Injections
2. October 18 to 23: Excavation of Hot Spot
3. October 23 to 28: Backfilling and compaction
4. October 29: Demobilization

Remediation to be completed within a month *or so …*



June 2021

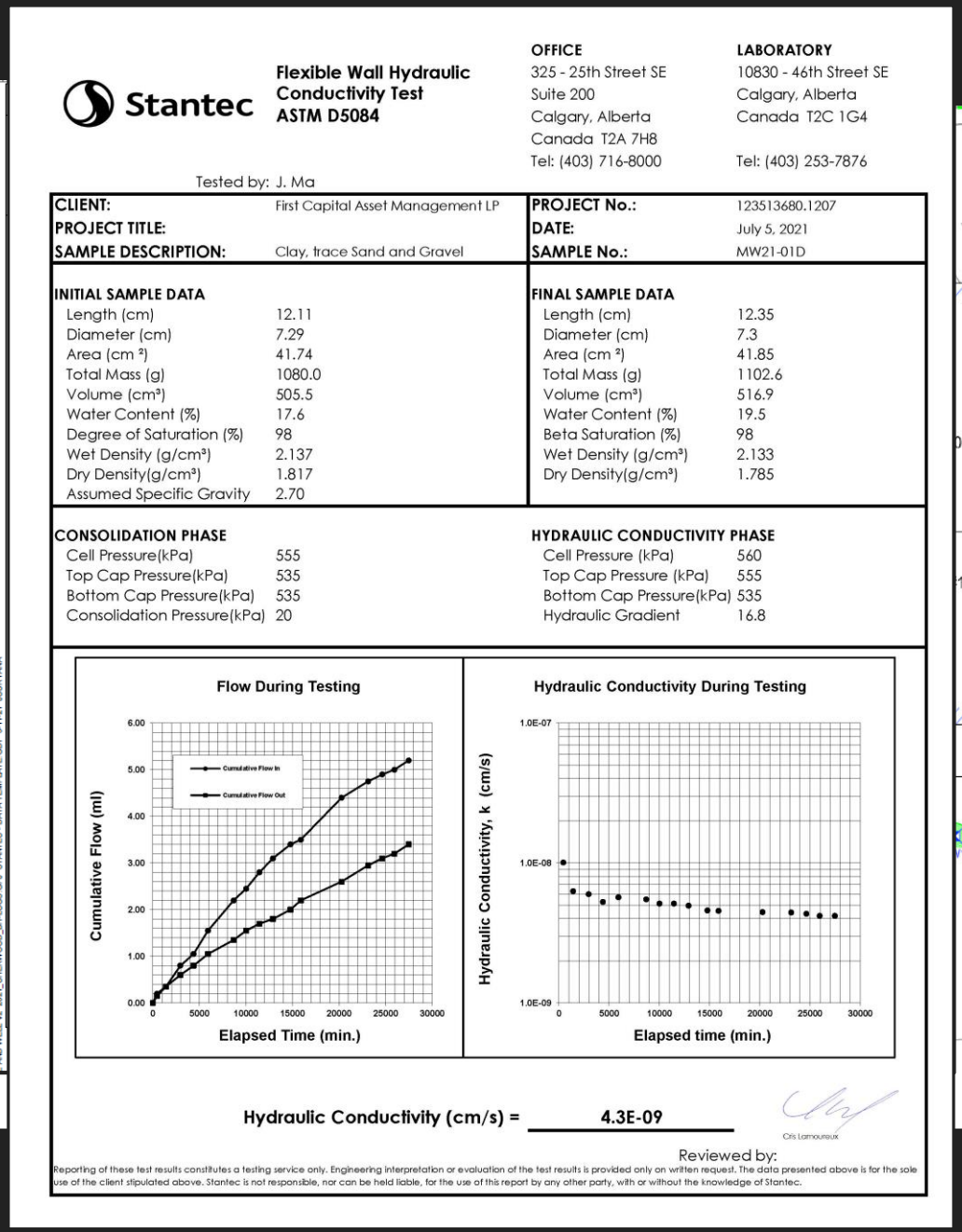
Supplemental Environmental Investigations (Pre-Remediation)

ALBERTA ENVIRONMENT AND PARKS, ALBERTA TIER 2 SOIL AND GROUNDWATER REMEDIATION GUIDELINES, 2019

(2019 AEP Tier 2 Guidelines – Commercial, Fine-Grained Soils with Pathway Exclusions)

ADDITIONAL INVESTIGATIONS:

1) Verification of Non-Potable Groundwater
2) cVOC Impact Delineation Investigations



Stantec

Flexible Wall Hydraulic Conductivity Test
ASTM D5084

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10830 - 46th Street SE
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Tested by: J. Ma

CLIENT:	First Capital Asset Management LP	**PROJECT No.:**	123513680.1207
PROJECT TITLE:		**DATE:**	July 5, 2021
SAMPLE DESCRIPTION:	Clay, trace Sand and Gravel	**SAMPLE No.:**	MW21-01D

INITIAL SAMPLE DATA		**FINAL SAMPLE DATA**	
Length (cm)	12.11	Length (cm)	12.35
Diameter (cm)	7.29	Diameter (cm)	7.3
Area (cm ²)	41.74	Area (cm ²)	41.85
Total Mass (g)	1080.0	Total Mass (g)	1102.6
Volume (cm³)	505.5	Volume (cm³)	516.9
Water Content (%)	17.6	Water Content (%)	19.5
Degree of Saturation (%)	98	Beta Saturation (%)	98
Wet Density (g/cm³)	2.137	Wet Density (g/cm³)	2.133
Dry Density(g/cm³)	1.817	Dry Density(g/cm³)	1.785
Assumed Specific Gravity	2.70		

CONSOLIDATION PHASE		**HYDRAULIC CONDUCTIVITY PHASE**	
Cell Pressure(kPa)	555	Cell Pressure (kPa)	560
Top Cap Pressure(kPa)	535	Top Cap Pressure (kPa)	555
Bottom Cap Pressure(kPa)	535	Bottom Cap Pressure(kPa)	535
Consolidation Pressure(kPa)	20	Hydraulic Gradient	16.8

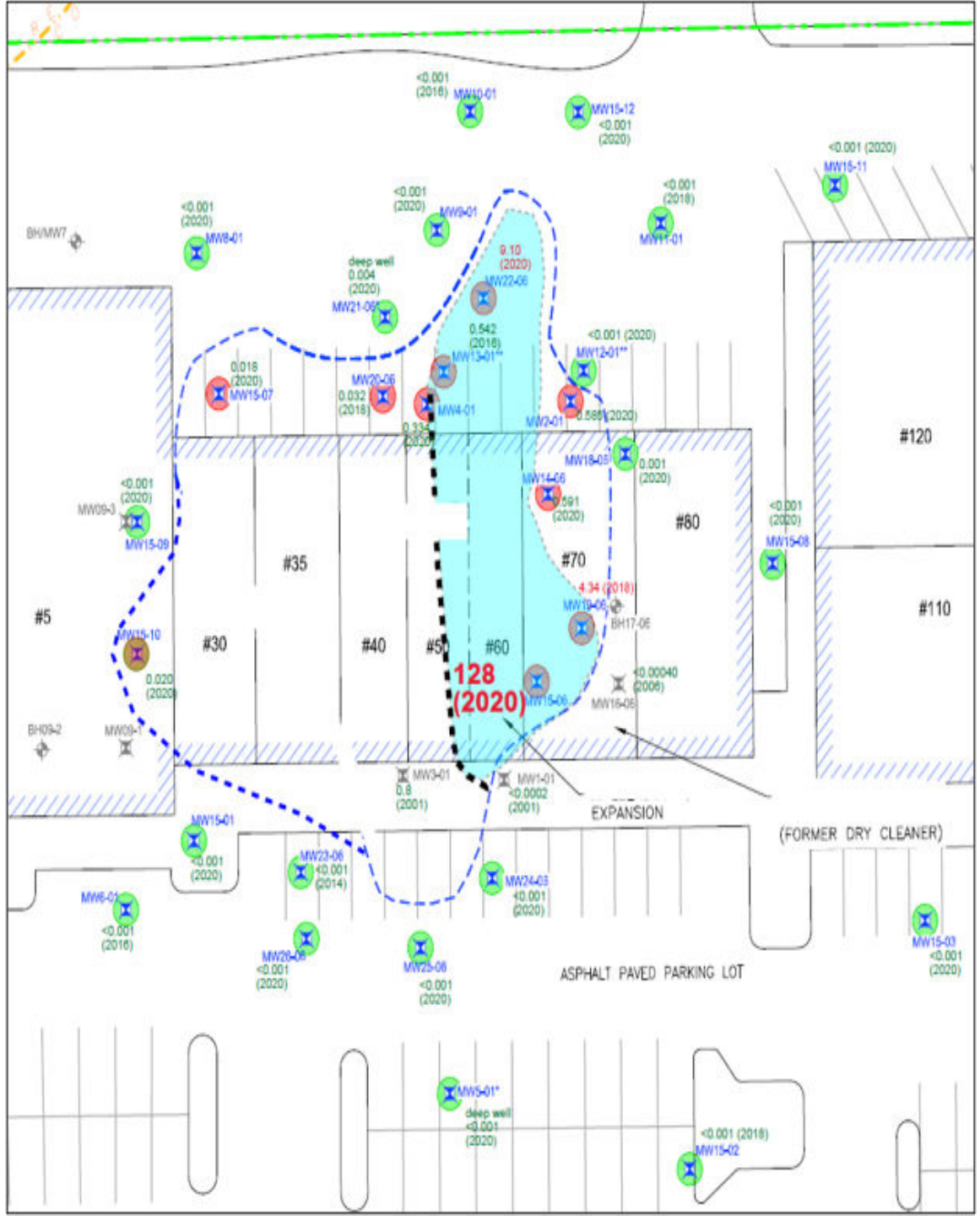
Hydraulic Conductivity (cm/s) = 4.3E-09

Reviewed by:

Reporting of these test results constitutes a testing service only. Engineering interpretation or evaluation of the test results is provided only on written request. The data presented above is for the sole use of the client stipulated above. Stantec is not responsible, nor can be held liable, for the use of this report by any other party, with or without the knowledge of Stantec.

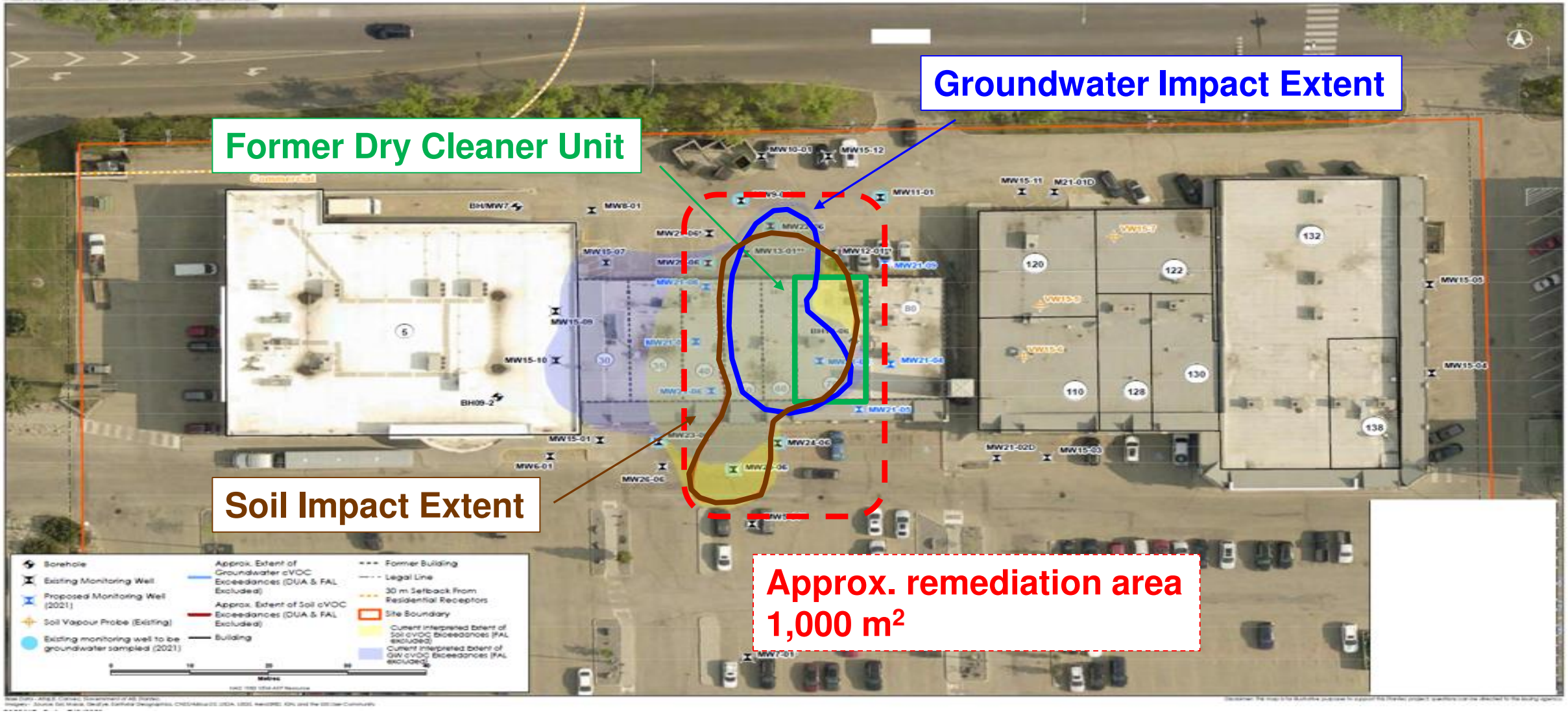
Soil Conditions

- Soil PCE concentrations of up to 1,330 mg/kg within the source area
- Soil PCE Guideline exceedances extended vertically down to 4.5 m BGS
- Presence of PCE degradation products (TCE, cis-1,2-DCE) in soils at low levels
- Soils are predominantly **fine-grained**
- **Soil hydraulic conductivities**:
  Shallow zone - 2.54 x 10^{-7} m/s
  Deeper zone - 4.91 x 10^{-9} m/s



Groundwater Conditions

- Groundwater PCE concentrations of up to 223,000 µg/L within the source area historically
- Groundwater PCE Guideline exceedances extended vertically down to 9.0 m BGS
- Presence of PCE degradation products (TCE, cis-1,2-DCE, trans-1,2-DCE) in groundwater at low levels
- Shallow groundwater depths ranged from 0.4 to 4.2 m BGS



Overview of Impact Conditions Pre-Remediation

Remediation Criteria for Success

- Meet regulatory standards, so active risk management measures are not required
- Effectively address hot spot beneath the building
  - Address shallow and deep groundwater contamination
  - Address soil contamination in the saturated and unsaturated zones
- Minimal disruption to operating shopping centre (customers, businesses and traffic)
- Completed remediation in collaboration with client's reconstruction of the building

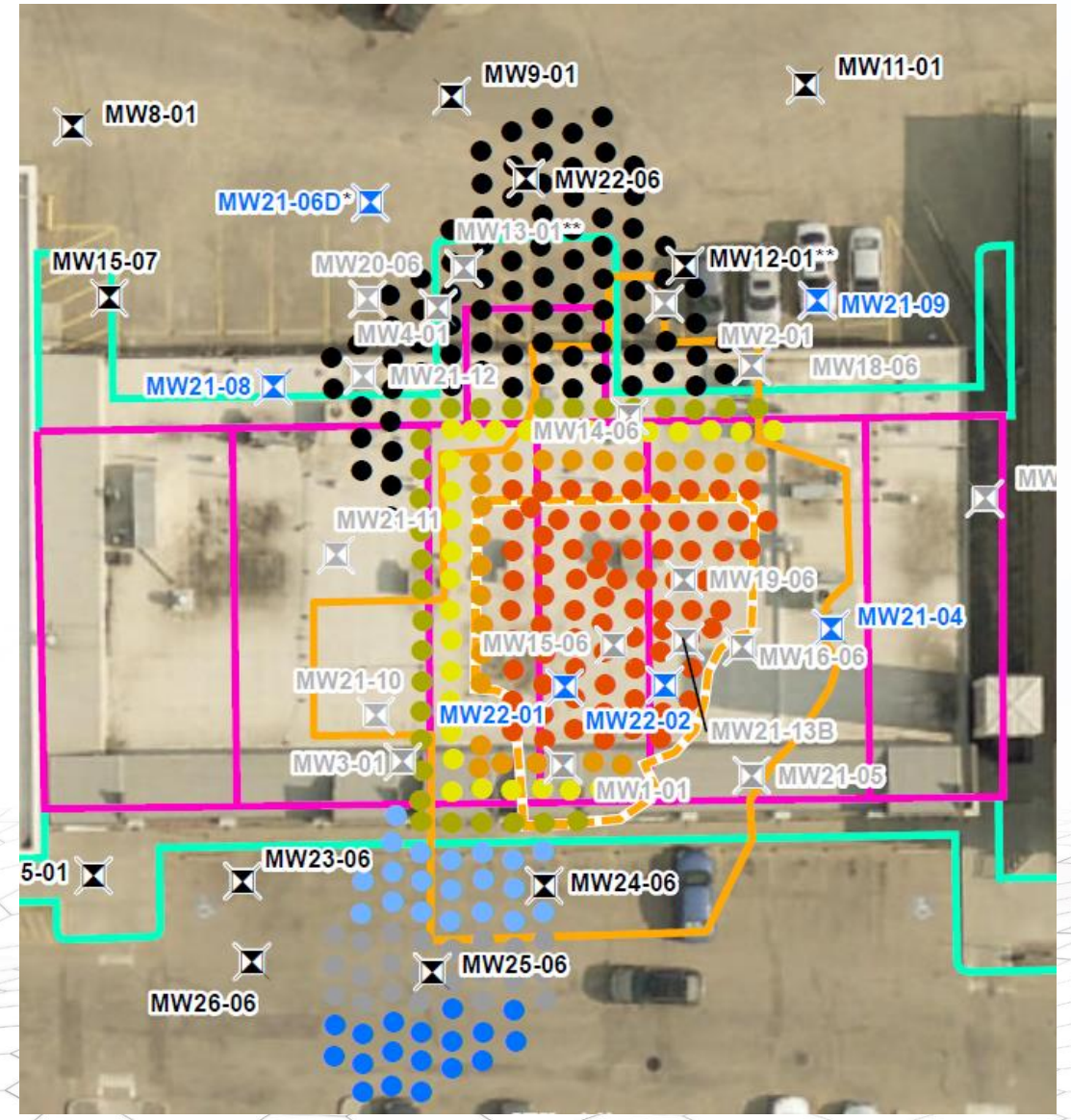
TRIUM Scope of Work

- Remediation Program Design
  - Working with First Capital (Enviro and Construction) and Stantec
- Complete Field Program – Prime Contractor
  - In-situ Program
  - Ex-situ Program
    - Re-circulation System
    - Base Amendments

Remediation Program and Schedule

- In-situ Chemical Reduction (ISCR)
  - Injection of EHC-L and KB-1
    - Microemulsion of a controlled-release, food-grade carbon, nutrients, and iron
    - Bioaugmentation species targeting all chlorinated compounds (Dhc)
  - Proposed 70,000 L in 300+ injections points
    - Source Area
    - Below the excavation walls
    - South Extent
    - North Extent

Remediation Program and Schedule



Injection Location

Excavation Walls
- 2 - 9 mbg
- 3 - 9 mbg
- 4 - 9 mbg

South Area
- 1.5 - 4.5 mbg
- 1.5 - 6.5 mbg
- 1.5 - 8.5 mbg

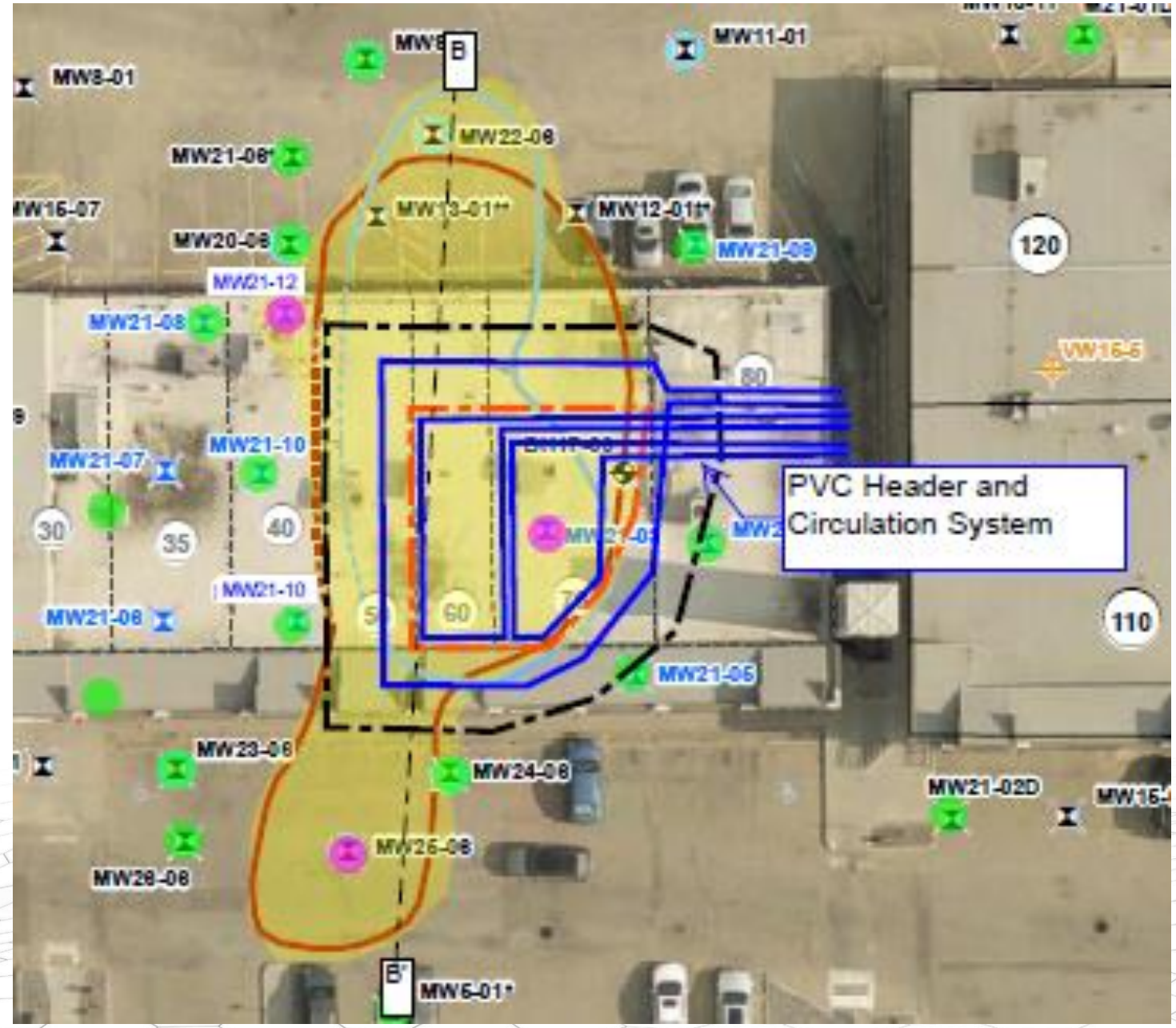
Source Area
- 6 - 9 mbg

North Area
- 1.5 - 9.0 mbg

- 2021 Monitoring Well
- Environmental Borehole
- Existing Environmental Monitoring Well
- Former Environmental Borehole
- Former Monitoring Well
- Floor Plan
- Sidewalk
- Legal Line
- Excavation Extent
- Extent of Excavation Floor
- Site Boundary

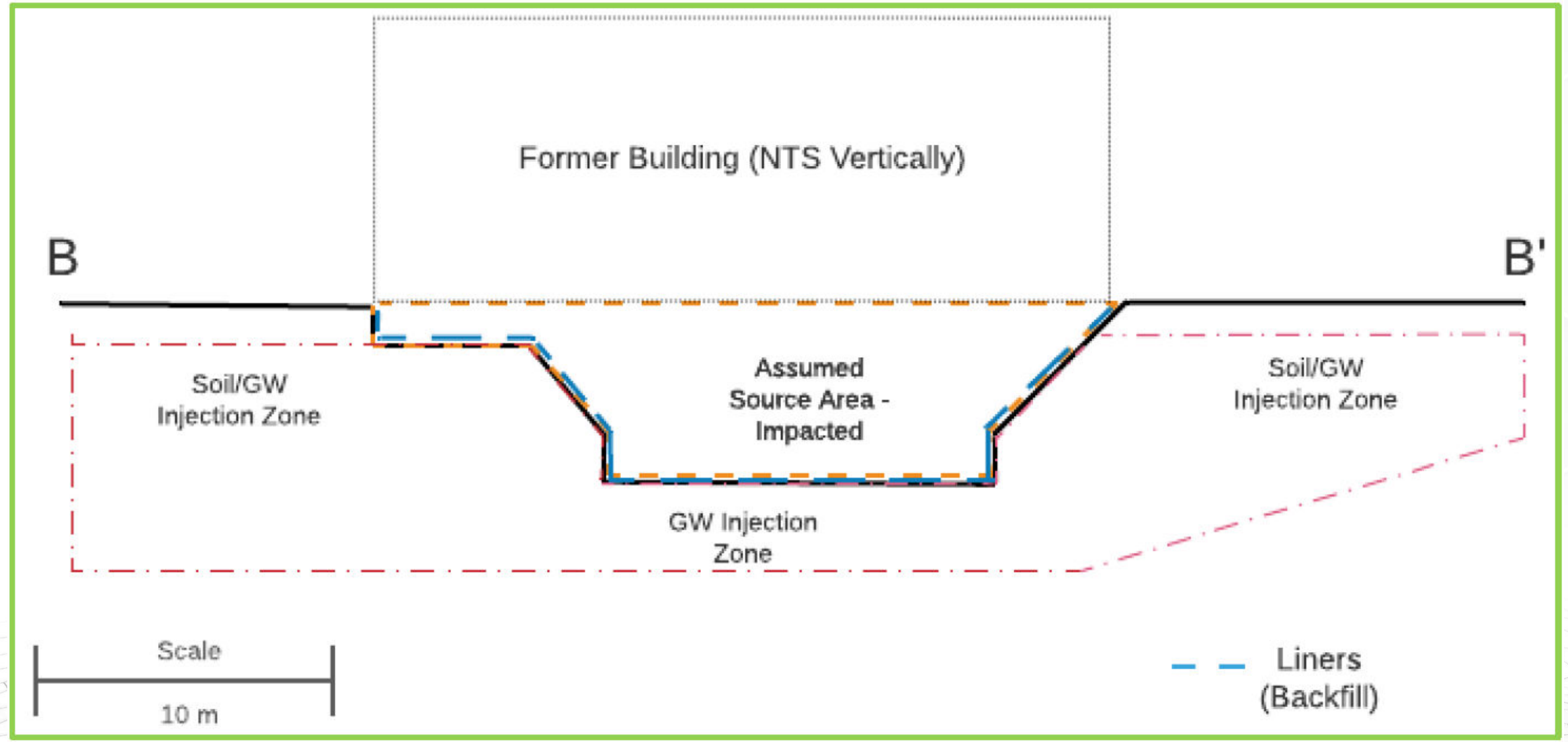
Remediation Program and Schedule

- Ex-situ Remediation
  - Excavation of source area
    - Volumes determined
      - 225 m^3 over burden (to be stockpiled onsite)
      - 1,400 m^3 impacted soils
    - Hot loading
    - Amendment at base of excavation
      - Daramend - controlled-release fermentable organic carbon substrate combined with macro size zero valent iron (ZVI).
  - Re-circulation System
    - Install at base of excavation and 3 mbg
    - Tie in to east side of property for future access
    - Liner Placement
    - Backfill excavation



Legend

Light blue – GW impacted area
Brown – Soil impacted area
Yellow – Soil and GW impacted area
Black – Upper extent of excavation
Red – Base of excavation
Blue – Circulation system


Former Building (NTS Vertically)
B
B'
Soil/GW
Injection Zone
Assumed
Source Area -
Impacted
Soil/GW
Injection Zone
GW Injection
Zone
Scale
10 m
Liners
(Backfill)

Remediation Program and Schedule

- Sept 27/28 – Project Kick-off and all contractors mobilize
- Sept 29 – Oct 26 – Complete injections
  - Holiday break
- Oct 18 – Mobilize Earthworks equipment
- Oct 19 – 23 – Complete Excavation
- Oct 23 – 28 – Complete Backfilling
- Oct 29 – Demobilize all Equipment

Remediation Program and Schedule (Actual)

- Sept 27/28 - Project Kick-off and all contractors mobilize
- Sept 29 – Nov 4 – Complete injections
- ~~Oct 18~~ – **Jan 10** - Mobilize Earthworks equipment
- ~~Oct 19 – 23~~ –**Feb 2** - Complete Excavation and demobilize equipment
- ~~Oct 23 – 28~~ – **Feb 8** - Complete Backfilling

Remediation Summary

Details	Proposed	Actual
Number of Points	300+	323
Volume of Injectate	70,000 L	71,077 L
Time spent on injections	26 days	37 days
Volume Excavated	1,400 m^3 (approx. 2,500 tonnes)	4,279 tonnes
Time spent on excavation	11 days	17 days

Remedial Excavation – Soil Confirmatory Sampling

Consultant Lessons Learned

- Seize the opportunity to remediate
- Be prepared for the unpredictability
- Collaboration among different teams is key
- Keep close eyes on construction progress

Key takeaways/ Lessons Learned

- Need to be adaptive with planning and scheduling when working with multiple stakeholders
- Installation of pilings prior to excavation required significant planning and work
- Winter excavation results in considerable changes for scope and safety

Landlord Lessons Learned

1. Delineation only provides the minimum excavation extent, depth and volume

2. Do not guarantee to stakeholders remediation costs and/ or timelines

3. Remedial action plans need to be adaptive to be able to address the remedial objective. The team matters!

4. Construction ~~(Redevelopment)~~ makes projects more complicated. Collaboration is key to be proactive to avoid surprises.

5. Unexpected events can present an opportunity for remediation

FIRST CAPITAL

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Questions or Comments ?